CURRICULUM

FOR THE TRADE OF

INSTRUMENT MECHANIC

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENURESHIP
DIRECTORATE GENERAL OF TRAINING

CONTENTS

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Co-ordinator for the course: Shri L.K.Mukherjee, DDT & Shri P. G. Rajendran, ADT

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2. BACKGROUND

2.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

(Need for Apprenticeship in Instrument Mechanic trade)

The demand for precise measurement and control of plant parameters are increasing day by day for modern industries that rely heavily on automation for economic viability and mass production. The availability of sophisticated instrument and variety of control devices has greatly improved not only the quality of the product but also contributed to the reduction of the cost. In the present times it is impossible to think of the industrial productions without instrument and control. The operation and safety of the plant relies on these instruments so the Instrument Mechanic is very important as they constantly monitor and calibrate these instruments.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Mechanic, Precision Instrument General tests, repairs, overhauls and assembles various precision instruments and their parts for efficient performance. Examines instrument for defects. Rectify the defects by appropriate procedures. Tests performance either by visual observation or by conducting simple electrical and mechanical tests and ensures that repaired or assembled instrument conforms to prescribed efficiency. May make new components and assemble new instruments. May specialize in any particular type of instrument like mechanical, hydraulic, pneumatic, electrical, optical, orthopedic etc.

Mechanic Precision Instrument, Mechanical makes, alters and adjusts mechanical instruments or mechanical parts of electrical and optical instruments by accurate milling, filing, grinding, lapping and other processes. Studies drawings or samples and examines precision instrument like balance, meters, pressure gauges etc. for defects. Dismantles instrument, cleans metal components in petrol, kerosene oil or otherwise and checks them to find out extent of damage and further serviceability. Makes necessary adjustments and seals meters to avoid manipulations. May specialize in particular type of instruments like balance, pressure gauges, meters, theodolites, etc. May make new instruments from blue prints.

Mechanic Optical Instruments repairs and sets optical instruments such as microscopes, telescopes, binoculars theodolites, photography cameras, sextants etc. for enlarged view photography for recording accurate measurements, etc. by checking centering, setting lenses to required focal length and adjusting other components to required perfection. Examines optical instruments for defects visually or by focusing it to standard observations. Aligns parts to requirement and assembles components to form complete unit. Makes necessary settings and adjustments to instruments and tests to repaired unit for clarity and efficiency by visual observations or by using them over fields to ensure desired result and accuracy. May assemble and fit new equipment.

Precision Instrument Makers and Repairers, other perform number of low skilled and routine tasks such as dismantling instruments, filing, making connections, operating vacuum machine, soldering, sealing covers, cleaning lenses etc., and is designated as Instrument Mechanic Mate, Instrument Mechanic Helper.

Instrument Mechanic supports the plant operation and all machines operation is safe & running correctly by conducting inspections and preventive maintenance. His job role involves skilled mechanical and electrical and electronic work such as

- Refer manuals, reading and interpreting circuit diagrams, blueprints and schematics
- inspecting and testing the operation of instruments and systems to diagnose faults using testing devices
- writing maintenance reports

- repairing and adjusting system components or removing and replacing defective parts
- calibrating components and instruments
- performing scheduled preventative maintenance work
- installing control and measurement instruments on existing or new plant equipment
- observing safety in accordance with government and company standards

Reference NCO: 7311.10,
7311.30,
7311.60,
7311.90

5. GENERAL INFORMATION

1. **Name of the Trade** **: INSTRUMENT MECHANIC**

2. **N.C.O. Code No.** : 7311.10, 7311.30, 7311.60, 7311.90

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 2years

3.1 **For Freshers :- Duration of Basic Training**: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: 6 months

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: 18 months

3.2 **For ITI Passed :- Duration of Basic Training**: - NIL

Duration of Practical Training (On -job Training): 12 months

4. **Entry Qualification** : Passed 10th Class under 10+2 System of Education or its equivalent

5. **Selection of Apprentices:** The apprentices will be selected as per Apprentices Act amended time to time.

6.Rebate to ITI Passed out Trainees : One year in the trade of Instrument Mechanic

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

5. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	Block– I	-----	Block – II	------
Practical Training (On - job training)	----	Block – I	------	Block – II

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

7. SYLLABUS

7.1 BASIC TRAINING (BLOCK – I & II)

DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **INSTRUMENT MECHANIC**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 8.07 KW for Workshop
5) **Space Norms** : 80 Sq.m.
6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

a) Degree/Diploma in Instrumentation/ Instrumentation control/Electronic Instrumentation Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

b) NTC/NAC in the trade of Instrument Mechanic with three year post qualification experience in the relevant field.
Preference will be given to a candidate with Craft Instructor Certificate (CIC)

c) **Tools, Equipments & Machinery required** : - As per Annexure – I

7.1.1 DETAIL SYLLABUS OF CORE SKILL

A. Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	**Engineering Drawing:** Introduction and its importance - Viewing of engineering drawing sheets. Method of Folding of printed Drawing Sheet as per BIS SP: 46-2003. Drawing Instruments: their Standard and uses. - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	**30**	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	**20**
2	**Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section). - Drawing lines of given length (Straight, curved). - Drawing of parallel lines, perpendicular line. - Methods of Division of line segment.		**Fractions & Simplification**: Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems. Simplification using BODMAS.	
3	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types. - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.		**Square Root:** Square and Square Root, method of finding out square roots, Simple problem using calculator.	
4	**Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke,		**Ratio &Proportion:** Simple calculation on related problems.	

	inclined, Upper case and Lower case.			
5	**Free Hand sketch:** Hand tools and measuring instruments used in electronics mechanics trades.		**Percentage:** Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	
6	**Free hand drawing :** - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with dimension. - Transferring measurement from the given object to the free hand sketches.		**Material Science** : Properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	**Symbolic Representation** (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Piping joints and fittings	**30**	**Mass ,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	**20**
2	Construction of Scales and diagonal scale P&I drawing symbols ISA 5.1 cable schedule		**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	
3	Electrical and electronics element and components LED, IRLED, photo diode, photo transistor, opto- coupler symbols symbols of Logic gates		**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	
4	Half adder, full adder, multiplexer and de-multiplexer		**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	
5	UJT, FET, MOSFET, DIAC, TRIC, SCR, IGBT symbols and circuits of FET Amplifier, SCR using UJT triggering, snubber circuit, light dimmer circuit using TRIAC, UJT based free running oscillator.		**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding height and distance by trigonometry.	

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I
Basic Training

Week No.	Professional Skills	Professional Knowledge
1	• Importance of trade training, List of tools & Machinery used in the trade. • Health & Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains. • **Occupational Safety & Health** • **Importance of housekeeping & good shop floor practices.** • Basic safety introduction. • Personal protective Equipments (PPE). • Use of Fire extinguishers.	• Importance of safety and general precautions observed in the in the industry/shop floor. • All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. • **Soft Skills: its importance and Job area after completion of training.** • Introduction of First aid. Operation of electrical mains. Introduction of PPEs. • Introduction to 5S concept & its application. • Response to emergencies eg; power failure, fire, and system failure.
2	**<u>Hand Tools and their uses</u>** • Demonstration and uses of hand tools- screw drivers, pliers, tweezers, tester, wire stripper, electrician knife, steel rule, scriber, punches, hack saw, hammer, files, bench vice and drilling machine. • Simple mechanical fixtures. • Identification of types of screws, bolts, nuts, washers, rivets, clamps, connectors. • Fix screws of different sizes on wooden boards. • Cutting of metal blocks using hand/hack saw. • Cutting of wooden blocks using hand/hack saw. • Simple fitting practice, drilling and grinding practice.	• Identification, specifications, uses and maintenance of commonly used hand tools. Its use for Chipping, filing, sawing, drilling, threading and metal cutting fundamentals. • Different types of Fasteners & Fastening devices and its use. • Working and use of drilling machines and grinding machines.
3	• Practice of Marking & measurement with the help of Precision Measuring Instruments. • Gauge blocks, sine bar, dial indicators. • Vernier Caliper, Vernier Height vernier calipers,	• Fundamental of marking tools its selection and use. • Working principle and operation of Precision Measuring Instruments, gauge blocks, sine bar, dial indicators. • Vernier Caliper, Vernier Height

	• Micrometers, bevel protractor, thickness gauges.	vernier calipers. • Micrometers, bevel protractor, thickness gauges.
4	**Basics of AC and Electrical Cables** • Verification of ohm's law. • Identification +Ve, -Ve polarities. • Identifying and use of various electrical components, their symbols. Wire size measurement technique. • Major D.C & A.C circuits. • Identify the Phase, Neutral and Earth on power Socket. • Use a Tester to monitor AC power. • Measure the voltage between phase and ground and rectify earthing. • Identify and test different AC mains cables. • Skin the electrical wires /cables using the wire stripper and cutter. • Prepare the mains cable for termination. • Identify the meter for measuring AC & DC parameters.	• Fundamentals of basic electricity, Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. • Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS. • P-P, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. • Insulators, conductors and semiconductor properties. • Different type of electrical cables and their Specifications. • Types of wires & cables, standard wire gauge (SWG).
5	• Identification, testing & running of Motors and generators. • AC/DC motors Different speed controlling techniques.	• Construction and working Principles of AC & DC Motors. • Electricity, types of wave forms, time period and frequency, peak to peak values, RMS values, Average values, Form factor.
6	• Overhauling & testing of ELECTRICAL INSTRUMENTS. • Familiarization with the construction, Overhauling. • Testing & calibration of instrument use for voltage, current, frequency, power, power factor and energy.	• Introduction to electrical measuring instruments, classification of meters, working principles and operation of different types of ammeters, voltmeters, **ohmmeters analog multimeter** and its effective use. • Working principles and operation of different types instrument use for Frequency, power, power factor energy and its effective use.
7	• Identify the different types of resistors. • Measure the resistor values using colour code and verify the reading by measuring in multi meter. • Measure the resistance, Voltage, Current through series and parallel connected	• Resistor-definition, types of resistors, their construction & specific use, color-coding, power rating. • Equivalent Resistance of series parallel

	networks using multi meter. • Identify different inductors. • Identify the different capacitors and measure capacitance of various capacitors using LCR meter.	circuits. Distribution of V & I in series parallel circuits. KVL& KCL with applications. • Principles of induction, inductive reactance, Capacitance and Capacitive Reactance, • Impedance. Types of capacitors, construction, specifications and applications. • Dielectric constant. Significance of Series parallel connection of capacitors. Electromagnetic Relays, types, construction, specifications- coil voltage and contact current capacity. • Multi meter, use of meters in different circuits. Use of CRO, Function generator, LCR meter.
8	• Identification, testing of Diodes transistors, UJT, SCR, TRIAC, DIAC. • Introduction of oscillators and amplifiers.	• Semiconductor physics. • Forward and reverse bias in diode. • Transistor configurations of CC, CB, CE. • Introduction of amplifier & oscillator and its applications.
9	• Identify the different types of electronics components using LCR meter. • Identification of deflection sensitivity, various controls of CRO. • Design of clipper, clamper circuit and identify the output waveforms in CRO.	• Basic electronics measuring instruments are CRO, Signal generators, digital storage oscilloscope. • Construction and working principle of CRO with internal structure. • Circuits of clippers, clampers, types of clamping design.
10	• Implementation of basic gates & universal gates and its output verification. • Ex-or and ex-nor gates design. • Half adder, full adder, half substractor and full sub tractor.	• Digital Electronics- number system, conversion from to another system, basic gates, its truth table, universal gates and its truth table. • Laws of Boolean algebra, De-Morgan's laws, using NAND gates design of basic gates, using NOR gates. • Half adder, full adder, half substractor, full substractor.
11	• Identification of various indicators, Connectors, ports on the computer cabinet. • Identify drives and their capacity.	• Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse and their working.

	• Identify various connectors and cables inside the cabinet & Identify connections to rear side and front panel of the cabinet. • Identify various parts of the system unit and motherboard. • Configuring and troubleshooting display problems. • Practice various features of OS. • Install a Printer driver software and test for print outs. • Install MS office software. • Explore different Menu/Tool/ Format/status bars of MS word and practice the options: Editing the text, saving the text, changing the font and size of text. • Prepare a power point presentation on any three known topics with various design features. • Invoke excel sheet from MS WORD and vice versa. • Identify the cables and network components. • Making UTP cross cables and testing, Making straight cables and testing, Making cable layout drawing.	• Different types of printers, their function and inter-connection and their advantages HDD, CDD, DVD. Various ports in the computer. • POST Booting concept.
12	• Assembly language programs on microcontroller address bus and data bus structure, width of data and address bus and its memory size • Program counter ,stack pointer etc.	• Basic of 8051 microcontroller, its address bus and data bus structure, width of data and address bus and its memory size. • Instruction sets and Registers of 8051 and their uses.
13	**Assessment / Examination (03 days)**	

B. Block –II
Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	-Study various types of instruments constructions and identifying various parts and section. -Record the specification of instrument. - Find out the characteristics of linear and angular Displacement Resistive Transducer. - Find out the characteristics of linear and angular displacement Capacitive transducer.	-Scope and necessity of instrumentation. -Fundamentals of measurement. Systems-functional block diagram of measurement system. – Basic role, types, characteristics, and Selection of sensor/ transducer for measurement. -Working principle, characteristics and applications of Resistive and capacitive Transducer.
2	-Select and verify characteristics of Strain gauges. - Study Construction, Purpose & Operation of load cells. -Study Construction & Operation of different types of Inductive, LVDT& RVDT Transducers for Displacement, Acceleration, Thickness and Vibration measurement .and verify the characteristics. -Study Construction & Operation of Vibrometers, and Accelerometers.	-Stress & Strain Measurement.-Working principle of Strain gauges, Types of Strain gauges, Bonding technique & Applications of Strain gauges. -Working principle and applications of Inductive, LVDT& RVDT transducers. - Measurement of vibration and acceleration. - seismic instrument.
3	**Pressure Measurement**. -Study construction, Operation and measure atmospheric pressures using different types of Barometers. -Prepare and Measure gauge, vacuum and differential pressures using different types of manometers. - Dismantling and assembling of pressure Gauges. Study the construction, adjustments for correct functioning. - study the construction, circuit operation and adjustments for correct functioning of electronic pressure indicators/ transmitters. - Study construction, Operation of Standard Calibrator/Dead weight Tester. - Testing & calibration of Pressure gauges, indicators, transmitters with Standard Calibrator/Dead weight Tester	- Principle of fluids Pressure, units of pressure, Factors affecting liquid pressure. Pressure relation with volume, temperature and flow. Types of pressure, their relation- ships.- - working principle of Barometers, manometers and applications. - Elastic types of pressure sensors, working and operation of bourdon tube, diaphragms, capsules, and bellows types of Pressure gauges switches and applications. -Working and operation of different types Electrical pressure transducer:- potentiometric, Capacitive , reluctance- servo, LVDT, strain gauge, piezoelectric pressure transducer working and application - Low Pressure Measurement using

	-measure vacuum using Vacuum gauges,, & McLeod gauge - maintenance of pressure lines, gauges, transmitters etc.	diaphragm Vacuum gauges, McLeod gauge , thermal conductivity gauges, pirani gauges, thermocouple gauges,. Ionization gauge, -Method of pressure instrument calibration. Working principle of Dead weight tester / comparators, low pressure testers. Importance of calibration in Metrology
4	**Flow Measurement** - Study construction and repairing various types of positive displacement flow meters. Oscillating piston type, Rotating vane meter, Nutating disc meter. - Study of various types of flow restrictors (orifice, venture, flow nozzle, Pitot tubes) their shape, connections and check etc. - Dismantling, checking overhauling and calibration of D.P. cell/ Transmitter (pneumatic & electronic). -Dismantling, checking overhauling and calibration of Rota meters - Study construction, operation and calibration of turbine flow meter, magnetic flow meters, vortex, mass flow meters etc. - practice open channel flow measurement. Study construction, operation flow elements and instruments - Maintenance of flow meters, flow transmitters and indicators.	-Basic properties of fluids, fluids in motion, units of flow rate and quantity flow, factors affecting flow rate, Reynolds number, -working principle of positive displacement flow meters. - Head type of flow meters: flow elements, pressure tapings, DP transmitters. -Variable Area type flow meter- rotameter, constructions, working principle, and application. -principle of working and application of Mass flow meters. Electronic inferential flow meters: principle of working and application magnetic flow meter. Turbine flow meter, vertex flowmeter, ultrasonic flow meter. -principle of open channel flow, weirs, notches and flumes. Various shapes and their applications, maintenance, - Solid flow measurements and application.
5	**Level Measurement** -Study construction, operation and calibration of Hook type, Sight glass and Float type level measuring instruments on close and open tank. -Dismantling, checking, overhauling and calibration of level gauges. - Study construction, operation and calibration of hydro Static pressure level measuring instruments, Bubbler system, differential pressure measurement for close and open tank. -Operation & calibration of Electronic Level Indicators and transmitters.	-Introduction to measurement of level, -The principle of operation, use and construction of Hook type, Sight glass type, Buoyancy type level indicator to close and open tank. - Hydrostatic method of level measurements: Air purge method, differential pressure technique. - Electronic Level Measuring Instrument: Variable capacitance, High and low level alarm ON-OFF, Ultrasonic and Magnetic type level indicators, radar type level indicators. - Solid level measurements: various principle of operation, and use.

	- Practice liquid level measurement using capacitive, Ultrasonic and radar type level indicators. - Preventive maintenance of level gauges , level indicating transmitters and switches etc.	
6	**Temperature Measurement** -Dismantling, Study construction, overhauling and calibration of bimetal, filled system thermometers and switches. -Calibration, maintenance & testing of Thermocouple, thermopiles, RTD, Thermostat, -operate, test and calibrate optical and radiation pyrometers -operation and use of electronic temperature calibrator and temperature baths for checking/ calibrating temperature measuring instruments and transmitters, - Routine maintenance of thermometers, transmitters, switches, compensating cables etc. -operation and use of humidity Sensor Instruments	-Measurement of Temperature: introduction, Temperature scales Solid Expansion Type- Bimetallic thermometers. Liquid Expansion Type-Mercury in glass thermometer, steel thermometers, Alcohol in glass thermometer, gas and Vapour Pressure thermometers. - Thermocouple & RTD Thermostat,:- their ranges, construction, principle of operation, compensating leads, - temperature Recorders , -principle of working and application of optical and radiation pyrometers etc. - Introduction of electronic temperature calibrator and temperature baths. - -principle of working and application of different types of humidity meters
7	**Converters servicing.** Reconditioning and Calibration of I/ P, P / I, E/I/, E/P, Electronic (power single and three phases), electric to hydraulic ETC. Converters. **Final control elements.** -Study the cut sections of various types of control valves /final control elements and its various components - Dismantling, fault finding, repairing, cleaning, reassembling and testing different types of control valves and actuators (electric, pneumatic, and hydraulic) - operation , servicing of valve positioned	**Converters**: Principle, Construction, operation of I to P, P to I,, E/I/, E/P Electronic (power single and three phase), electric to hydraulic ETC. Converters. **Final control elements** in process loops. Working principle, operation and applications of Final control elements, actuators (electric, pneumatic, and hydraulic valve), and valve positioned in process loops. Control valve mechanical considerations, selecting control valves, valve positioner.
8	**Automatic Industrial control.** -study the closed loop & open loop system - Study the construction, Identification of components of ON-OFF type and PID type controllers (pneumatic and electronic) in the	**Introduction to automatic** **Industrial control.** – Basic block diagram of control systems. Open loop, Closed loop system. Dynamics of Process, feedback and feed

	various fields. -Rig up ON-OFF type and PID type controllers (pneumatic and electronic) to unit operation and Observe the responses. -Study operation on cascade, ratio, feed forward control. -Identification of Pneumatic and Hydraulic control circuit components. -Rig up pneumatic and hydraulic control circuit and Observe the responses-Dismantling and assembling of various valves.	forward control system, -Discontinuous Modes of Controller: two position, multi position, single speed and multi speed floating control. -Continuous Modes of controller: ON/OFF, Proportional, integral derivative, PI, and PID -Principle and operation of Electronic, programmable digital and pneumatic controllers and its application, -cascade, ratio, feed forward control. -Basic principle Pneumatic and Hydraulic, Function of Control circuit component and its application
9-10	**PLC** -Indentify all the modules of plc used in system. -Wire and connect the digital and analog field devices to the I/O modules. -Write and execute small program on logic control, and sequence control -Study various network lines. Preparation of network cables and connectors. Testing network cables	**PLC** -Fundamentals of Programmable logic Controllers.-PLC architecture- Function of different modules, Hardware selection and configuration- PLC symbols-PLC programming for application. **- Fundamentals of Net working:** Types of networks used in digital Instrument systems. LAN, WAN , Ethernet. Types of Cable categories (CAT), and their descriptions. Various types of Cable connectors Various tools used in networking.
11	**Telemetering servicing:** Study construction, Reconditioning, replacement of parts, adjustment and calibration of transmitters (different type) for process variables. Installing &Operating HART transmitters/ devices (I/O). Calibration of HART devices. **DCS & SCADA** Study and use of DCS & SCADA complete with communication system for automatic process control, -Indentify all the modules of used in system	**Telemetering:** Telemetering in process control, types of SMART transmitters, principle of working of different pressure, flow, level, temperature, etc. Transmitters. **Smart devices:** need of smart devices, HART transmitters features & applications. Working method of HART devices, HART protocol. HART communicators and PC based HART device configuration. Steps in calibration of HART devices. - **Fundamentals of DCS & SCADA,.** History of DCS development. Basic architecture, function of different modules & applications.
12	**Analytical instruments**: - Study the panel control and its function, operation and calibration of the PH meter Conductivity meters, Calorimeter, gas analyzer, Dissolved oxygen meter.	**Analytical instruments:** Principle, accessories, Function & industrial application of the PH meter Conductivity meters, Calorimeter, gas analyser, Dissolved oxygen meter.
13.	**Recorders data loggers** checking, fault	**Recorders:** Introduction to recorders, data

	finding, repairing, testing of pneumatic, electrical/ electronic recorders.(single point & multipoint), Check Calibrate paperless LCD/LED recorder.	loggers Construction, working principle, various parts installation and use of pneumatic and electronic recorders. Strip chart, circular chart. Multi points paperless LCD/LED recorder etc.
14.	**Assessment / Examination (03 days)**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only.
3)	**Hours of Instruction**	**:**	**110 Hrs. (55 hrs. in each block)**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in Sociology/Social Welfare/Economics with two years experience and trained in Employability Skill from DGT Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGT Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar:** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading:** Reading and understanding simple sentences about self, work and environment	
4	**Writing:** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English:** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS. The user interface of Windows, Create, Copy, Move and delete Files and Folders. Use of External memory like pen drive, CD, DVD etc. Use of Common applications.	
3	**Word processing and Worksheet:** Basic operating of Word Processing, creating, opening and closing documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.	
4	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks). Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser,	

	Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills:** Communication and its importance. Principles of Effective communication. Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body – language. Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise.	
2	**Listening Skills:** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training:** Characteristics Essential to Achieving Success, The Power of Positive Attitude, Self awareness, Importance of Commitment, Ethics and Values, Ways to Motivate Oneself, Personal Goal setting and Employability Planning, Case study/Exercise	
4	**Facing Interviews:** Manners, Etiquettes, Dress code for an interview, Do's & Don'ts for an interview.	
5	**Behavioral Skills:** Organizational Behavior, Problem Solving, Confidence Building, Attitude, Decision making, Case study/Exercise.	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**15**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, the process of setting up a business.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**Institutions Support** Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**15**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	

2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**10**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining	

	qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)

(BLOCK – I & II)

DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) **Name of the Trade** **: INSTRUMENT MECHANIC**

2) **Batch size** : : a) Apprentice selection as per Apprenticeship Guidelines

b) Maximum 20 candidates in a group

3) **Examination** : i) The internal assessment will be held on completion of each block

ii) NCVT exam will be conducted at the end of 2nd year.

4) **Instructor Qualification** :

a) Degree/Diploma in Instrumentation/ Instrumentation control/ Electronic Instrumentation Engg. from recognized university/Board
With one/two year post qualification experience in the relevant field.

OR

b) NTC/NAC in the trade of Instrument mechanic with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

5) **Infrastructure for On Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON- JOB TRAINING

A. BLOCK – I

1. **Safety and best practices (5S, KAIZEN etc.)**
2. **Record keeping and documentation**
3. **Identification and testing of electronic components/devices**
4. **Repair & Maintenance work**

DURATION: 09 MONTHS (39 WEEKS)	
SL NO	**LIST OF OPERATIONS/SKILLS TO BE COVERED DURING INDUSTRIAL TRAINING**
1.	Study of personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handing of hazardous chemicals and poisons substances.
2.	Understand the different activities of the plant with plant capacity and production.
3.	Preparing a Schematic Layout and study of the process and operation of the plant.
4.	Perform basic workshop operations using he suitable tools for fitting riveting, drilling etc observing suitable care & safety.
5.	Understand the working principle of electrical measuring instruments. Finding faults and trouble shoot calibrate, connect common electrical measuring instruments, Continuity Testers, meggers, earth resistance testers and multi meters.
6.	Test, connect with devices, start and control and reverse the direction of rotation of DC motors AC single phase and three phase induction motors, synchronous motors.
7.	Read, understand and interpret electrical (Single line diagrams& MCC Panel wiring) & electronic circuits and its drawings.
8.	Prepare, cable glanding, crimp, terminate and test various power/instrumentation cables used in industries.
9.	Soldering practice, metal to metal, wire to wire, wires to plugs, wires to connectors, wires to component PCB and de-soldering work.
10.	Test basic electrical(MCBs, push buttons, relay, contactors)/electronic components (diodes, transistors, capacitors, coils, resistors etc.) using proper measuring instruments.
11.	Configure, install, troubleshoot, upgrade, interconnect given computer system.
12.	Simulate and analyze the basic analog and digital circuits.

B. BLOCK – II

1. **Safety and best practices (5S, KAIZEN etc.)**
2. **Store procedure, Record keeping, inventory management and documentation**
3. **Identification and testing of electronic components/devices**
4. **Repair & Maintenance work.**

DURATION: 09 MONTHS (39 WEEKS)	
SL. NO.	**LIST OF OPERATIONS/SKILLS TO BE COVERED DURING INDUSTRIAL TRAINING**
1.	Demonstrate of location of the various sensing element, transmitter, controller, final control valve of a control loop.
2.	Demonstrate and apply the mounting arrangements for field & control room instruments (Panel mounting, Wall mounting, Yoke mounting etc.).
3.	Care, safety and proper use of hydraulic & pneumatic tubing & fittings, coupling and connectors.
4.	Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators. Connection of pneumatic instruments & adjustment as per name plate.
5.	Removal and Re-Fitting of a plant instrument after properly isolating the section of plant. Plant Procedure like SOP work order, clearance Certificates should be noted down by the apprentices.
6.	Understand and apply routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores.
7.	Calibration and Testing of temperature sensing elements (thermocouple, RTD etc.) and other related instruments used in plant.
8.	Calibration and Maintenance of field instruments (pressure, flow, level, temperature etc.) and panel instruments (indicator, controller, convertor, recorder) used in instrumentation field.
9.	Dismantle, inspect, calibrate and assemble Control Valves, Valve Positioner, Convertor, various types of final elements and actuators.
10.	Familiarization, Installation and Maintenance of Control Loops and components (sensing clement, single indicator/recorder, controller and final control element), relays and annunciator.
11.	a) Familiarization with instrument drawing in sketching, identification of instruments symbols and blocks diagrams of existing units in the plant. b) Instrument and Panel Installation as per layout plan.
12.	Understand the working principle of PLC, DCS & SCADA system in the industry.

8. ASSESSMENT STANDARD

8.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- Good skill levels in the use of hand tools, machine tools and workshop equipment
- Many tolerances while undertaking different work are in line with those demanded by the component/job.
- A fairly good level of neatness and consistency in the finish
- Occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- Good skill levels in the use of hand tools, machine tools and workshop equipment
- The majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- A good level of neatness and consistency in the finish
- Little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- High skill levels in the use of hand tools, machine tools and workshop equipment
- Tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- A high level of neatness and consistency in the finish.
- Minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST (SUMMATIVE ASSESSMENT)

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	**08 hrs.**
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50		50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under all India trade test.

9. FURTHER LEARNING PATHWAYS

On successful completion of the course,

- The trainees will be employed in reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (lateral entry). {Applicable for candidates only who undergone ATS after CTS}
- They can also undergo CITS course in the relevant trade to become instructor in the ITI's

Employment opportunities:

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Production & Manufacturing industries.
2. Infrastructure, defence organisations.
3. Instrumentation & process industries.
4. In public sector industries like HPCL, BPCL, IOC, NTPC, etc and private industries in India & abroad.
5. Self employment.

ANNEXURE – I

10. TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: INSTRUMENT MECHANIC

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A: TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Steel Rule 150 mm (metric and English Marking)	20 nos.
2.	Watch maker screw driver (set of six)	20 nos.
3.	Plier flat Nose 100 mm	20 nos.
4.	Hammer ball pain 250 gms. With handle	20 nos.
5.	Twiser fine point 125 mm	20 nos.
6.	File hand smooth 200 mm	20 nos.
7.	File Flat 2^{nd} cut 200 mm	20 nos.
8.	Screw driver set of 5 pieces	20 nos.
9.	Adjustable spanner	20 nos.

B: TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

Sl. No.	Name of the items	Quantity (indicative)
1.	Neon (phase) tester 230 volt	4 nos.
2.	Eye glass 3” focus watch maker	4 nos.
3.	Angle plate 150×100	2 nos.
4.	Vee block with clamp pair	2 nos.
5.	Hacksaw frame adjustable 200 – 300 mm	8 nos.
6.	Hammer ball pain 450 gms. with handle	2 nos.
7.	Electric soldering iron 6 watt pencil tip	4 nos.
8.	Vice bench jaw 100 mm	4 nos.
9.	Pointer extractors (puller)	4 nos.
10.	Punch center 100×10 mm	2 nos.
11.	Plier side cutting 150 mm	2 nos.
12.	Flaring tool set	1 set
13.	Micrometer outside 0 to 25 mm	1 no.
14.	Micrometer outside 25 to 50 mm	1 no.
15.	Vernier height gauge 300 mm	2 nos.
16.	Combination set 300 mm	1 no.

17.	Vernier caliper 150 mm	2 nos.
18.	Standard wire gauge	1 no.
19.	Feeler gauge leaf type, 26 blades, eng.& metric	1 no.
20.	Radius gauge leaf type 1 to 15 mm	1 no.
21.	Dial test indicator in mm with accessories.	1 no.
22.	Micrometer inside 25 mm with extension up to 150 mm	1 no.
23.	Combination plier heavy duty 150 mm	6 nos.
24.	Fire buckets	4 nos.
25.	Tube cutter	1 no.
26.	Tube bender	1 no.

C: GENERAL MACHINERY INSTALLATIONS:-

Sl. No.	Name & Description of Machines	Quantity (indicative)
1.	Digital panel meters, 4 digit	6 nos.
2.	Digital line frequency indicator	2 nos.
3.	D.C. regulated power supply (+/-15V / +/- 30V)	2 nos.
4.	Digital multi signal generator (1 MHz) with frequency counter (8 digit or 10 MHz)	1no.
5.	Digital function generator	1 no.
6.	Pulse generator	1 no.
7.	Digital insulation tester and megger	1 no. each
8.	Digital multimeter	2 nos.
9.	Analog multimeter	2 nos.
10.	Digital L.C.R. bridge	1 no.
11.	Wire type strain gauge (load cell/cantilever beem) Instrument/Trainer	4 nos. (2 nos. each)
12.	Vibrometer sensing elements with application Trainer	2 nos.
13.	Accelomerter	1 no.
14.	Seismic instruments	2 nos.
15.	Decade resistance , capacitive and inductance boxes	1 no. each
16.	DC moving coil miliammeters (various ranges)	2 nos.
17.	Centre zero galvanometers	2 nos.
18.	AC moving iron type voltmeter (various ranges)	3 nos.
19.	AC moving iron type ammeter (various ranges)	3 nos.
20.	Wattmeter dynamometer type	1 no.
21.	Power factor meter	1 no.
22.	Watt hour meter induction type 1 ph	2 nos.
23.	Ampere hour meter	1 no.
24.	Ohm meter	2 nos.
25.	Instrumentation amplifier trainer	1 no.
26.	Trainers on network circuits	1no

27.	Discreet component trainer	1 no.
28.	Trainers on linear circuits i.e. operational amplifiers	1 no.
29.	Trainer on basic digital electronics i.e. logic gates Boolean Expression adder subtractor flip flop counter register converter etc.	1 no.
30.	Trainers on power supplier's half wave rectifier full wave regulated power supply	2no.
31.	SCR driven/controlled power supply trainer	1 no.
32.	Micro Controller Trainer	1 no
33.	Trainer on RS 485 to RS 232 converter.	1 no. each
34.	Pressure Comparator	1 no.
35.	Pressure regulators with filter and input & output gauges	1 no.
36.	pressure transmitter for gauge and vacuum	1 no. each
37.	Differential pressure transmitter (electronic -	1 no.
38.	Bourdon tube type, bellow type and Diaphragm type pressure gauges of various ranges	2 nos. each
39.	Pressure measurement trainer	1 no.
40.	Pressure controller	1 no.
41.	Pressure switches of various ranges	4 nos.
42.	Different types of manometers	1 no. each
43.	P to I and I to P converters	1 no. each.
44.	Vacuum tester with Low pressure measuring gauges such as thermal conductivity (pirani) gauge McLeod gauge, and vacuum pump.	1 no. each.
45.	Vacuum gauge 100 mm dial bourdon tube type	1 no.
46.	Simple tank type quantity meter	1 no.
47.	Impeller type flow meter	1 no.
48.	Deflecting and rotating vane type flow meter	1 no. each.
49.	Helical and turbine flow meter	1 no.
50.	Pitot tube flow meter	1 no.
51.	Orifice type flow meter	1 no.
52.	Ventury tube flow meter	1 no.
53.	Rotameter	1 no.
54.	Magnetic flow meter	1 no.
55.	Vortex flow meter	1 no.
56.	Flow measurement and control trainer	1 no.
57.	Solid flow measurement and Control trainer	1 no.
58.	Flow DP transmitter	1 no.
59.	Integrated direct level indicator trainer (Hook type, sight glass type, float type level indicator)	1 no.
60.	Static pressure and air purge type level indicator	1 no.

61.	Electrical Type Level indicating transmitter with application trainer	1 no. each
62.	Level controller	1 no.
63.	Level measurement equipments for solid, sonic solid level, microwave, capacitance probes, diaphragm switches, nuclear gauge, sonic and microwave solid level detectors point level detector, conductivity type	1 no. each
64.	Stem and dial type bimetallic thermometer(various ranges)	2 nos.
65.	Lliquid , Gas and Vapour pressure thermometer	2 nos. each
66.	Temperature Trainer consisting of, RTD'S, thermister and different types Thermocouple.	1 no.
67.	Temperature transmitter, pneumatic	1 no.
68.	Temperature transmitter electronic (input RTD, TC)	1 no.
69.	Temperature Digital Indicator	2 nos.
70.	Pyrometer with all accessories	1 no.
71.	Trainer for measuring and controlling of temperature	1 no.
72.	Temperature digital Controller	1 no.
73.	Digital temperature calibrator, mV/mA injector and measuring unit	1 no. each
74.	Pneumatic and electronic recorders (single point and multi point) both circular and strip chart types	1 no. each
75.	Paperless LCD/LED recorder setup	1 no.
76.	Programmable logic controller (micro PLC) trainer	1 no.
77.	Real PID controller trainer	1 no.
78.	Electric actuators	1 no.
79.	Pneumatic and hydraulic actuators	1 no.
80.	Different type of control valves such as gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves etc. eclectically actuated, pneumatic actuated and hydraulic actuated	1 no. each.
81.	Valve petitioners, booster relays, gland pickings etc.	1 no. each.
82.	Cut section models of various type of control valve	1 no. each.
83.	Air compressor	1 no.
84.	Hydraulic trainer	1 no.
85.	Pneumatic trainer	1 no.
86.	Conductivity meter AND Experimental set up for online conductivity measurement	1 no. each
87.	pH meter Experimental set up for online pH measurement	1 no. each
88.	Different type of Hygrometer	1 no. each
89.	Hydrometer	1 no.
90.	Experimental set up for online dissolved oxygen measurement	1 no.
91.	Computers (latest configuration) with tables(For operating various control system trainers) Licensed operating system, Latest Office (licensed version)	04 nos.

92.	LCD multimedia projector	01 no.
93.	Broad band internet connection	01 no.
94.	Printer (Scan/copy)	01 no.
95.	Networking tool kit	02 nos.

Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: INSTRUMENT MECHANIC

LIST OF TOOLS& EQUIPMENTS FOR 20 APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A: TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (Indicative)
1.	Draughtsman drawing instrument box	20 nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 nos.
4.	Mini drafter	20 nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 nos.

B: FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	1 no.
6	White Board (size: 8ft. x 4ft.)	1 no.
7	Trainer's Table	1 no.
8	Trainer's Chair	1 no.

ANNEXURE – II

11. INFRASTRUCTURE FOR ON JOB TRAINING

TRADE: INSTRUMENT MECHANIC

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

12. GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.